

In the matter of the Stockyard Hill Wind Farm

Planning Panels Victoria

Proponent: Stockyard Hill Wind Farm Pty Ltd

**Expert Witness Statement of
Christopher Paul Turnbull**

Expert of Stockyard Hill Wind Farm Pty Ltd

1 Name and address

Christopher Paul Turnbull
17 Ruthven Ave
Adelaide, South Australia

2 Qualifications and experience

Appendix A contains a statement detailing my qualifications and expertise and addressing the matters set out within Planning Panels Victoria's Guide to Expert Evidence.

3 Scope

3.1 Role in Preparation of the Amendment Application

My firm "Sonus" was responsible for the preparation of the technical report titled "S3425C56 Stockyard Hill Wind Farm Environmental Noise Assessment to accompany an application to amend Planning Permit No. PL-SP/05/0548" (the Environmental Noise Report), which was submitted by Stockyard Hill Wind Farm Pty Ltd as part of its Amendment Application. Amongst other things, this report addressed the difference between a rotor diameter of 104m of the permitted Wind Energy Facility (WEF) and a rotor diameter of 140m for the amended WEF. I directed the assessment and reviewed all components of the assessment.

I also wrote the letter with the reference, "S3425C57" (the Sonus Letter), which considered the environmental noise implications of the increase in rotor diameter from 140m to 142m.

3.2 Instructions

My instructions to prepare this witness statement are set out in Appendix A.

3.3 Process and Methodology

An extensive background noise survey was conducted at 45 locations for a period of approximately six weeks at each location.

Following the background noise survey, criteria were determined based on the New Zealand Standard NZS6808:2010 (NZS6808:2010) and the agreements with some landholders. An assessment of the potential for the area to be classified as “high amenity” in accordance with NZS6808:2010 was conducted and it was determined that the area should not be classified as high amenity based on the Cherry Tree Wind Farm Judgment in VCAT as well as an assessment of the predicted noise at 6m/s in accordance with NZS6808:2010.

The prediction of environmental noise has been conducted based on the specified sound power levels of three representative examples of potential turbines, which meet the amended proposed Turbine Dimension limits. The example turbines were:

- General Electric 3.2-130 with a hub height of 110m;
- Vestas V136 3.45MW STE with a hub height of 112m; and
- Senvion 3.4M-140 with a hub height of 110m.

The predictions were made using the CONCAWE noise propagation model and SoundPLAN noise modelling software. Although NZS6808:2010 indicates that ISO9613-2 is an acceptable noise model, it is designed for predicting noise for wind speeds up to 5m/s. Therefore for a wind farm, several adjustments need to be used to modify the model for wind farm noise. These adjustments include assuming the receiver height is 4m high (even though it is 1.5m high) and adding a factor of 3 dB(A) when the propagation path is considered to be concave. When these factors are applied to an ISO9613-2 model and not applied to the CONCAWE model, the predictions are comparable.

The CONCAWE propagation model considers the following influences:

- sound power levels and locations of noise sources;
- separation distances between noise sources and receivers;
- topography of the area and influence of the ground;
- air absorption; and,
- meteorological conditions.

I understand that a peer review of the CONCAWE predictions has been conducted using the ISO9613-2 model and that the criteria are achieved with both models.

4 Findings

4.1 Summary of Opinions

I have reviewed the Environmental Noise Assessment and the Sonus Letter in preparing this expert witness statement and I adopt these reports as the basis of my evidence before Planning Panels Victoria. A summary of the outcomes is provided below.

The following criteria were adopted:

- For non-participating landowners, wind farm sound levels $L_{A90(10min)}$ should not exceed the background sound level by more than 5dB, or a level of 40 dB $L_{A90(10min)}$, whichever is the greater.
- For participating landowners, wind farm sound levels $L_{A90(10min)}$ should not exceed the background sound level by more than 5dB, or a level of 45 dB $L_{A90(10min)}$, whichever is the greater.

Appendix I of the Environmental Noise Assessment shows a noise prediction contour of the most conservative representative turbine (of the turbines assessed) at the most conservative (resulting in the night noise level) wind speed (10m/s). The noise contour shows that all non-participant dwellings are outside of the 40 dB(A) contour and therefore comply with the base 40dB(A) limit of NZS6808:2010, even without considering the influence of the background noise environment (in accordance with NZS6808:2010). The contour also shows that all participant dwellings are outside the 45 dB(A) contour, other than those that have been (or are under option to be) acquired by SHWFPL.

Both the permitted WEF and the amended WEF include indicative layouts and turbine models based on the understanding that the final turbine model and resulting layout will be determined by a competitive tender. Therefore, the noise experienced at dwellings is limited by reference to objective noise limits, rather than by reference to a particular layout or turbine model. In these circumstances, the most relevant comparison of the noise from the permitted WEF and the noise from the amended WEF is a comparison of the permitted and proposed noise limits. Although some procedures are different between NZS6808:1998 and NZS6808:2010, the difference in applicable noise limits at dwellings is negligible. Therefore, the noise at dwellings from the compliant amended WEF will be no greater than the noise from the compliant permitted WEF.

An analysis of indicative turbine selections for the permitted and amended WEFs indicates that depending on the turbine model used, the predicted noise at some non-participant dwellings from the amended WEF is up to 3 dB(A) higher and as much as 5 dB(A) lower than the predicted noise from the permitted WEF. That is, while there is an increase or decrease in noise at some dwellings associated with the amended WEF, the

predicted noise at these dwellings complies with NZS6808:2010 for both the amended and permitted WEF

4.2 Response to Submissions

I have reviewed the following submissions which raise issues concerning Environmental Noise: 3, 6, 7, 8, 9, 10, 12, 14, 18, 22, 23, 25, 26, 27, 28, 30, 34, 38, 39, 40.

My detailed response to the matters raised in these submissions is set out in Appendix C.

4.3 Amended Planning Permit Conditions

I reviewed the original planning permit conditions relevant to environmental noise and provided recommendations for modifications in the Environmental Noise Assessment. I understand that these recommendations formed the basis for the suggested noise related conditions in the application. The most significant changes were:

- The removal of Conditions 19, 20, 21 and 22 as these conditions require a comprehensive background noise assessment, which has already been conducted since the issue of the original permit conditions.
- The replacement of Conditions 18, 27, 28, 29, 31, 32 and 39 with more contemporary conditions based on Example Permit Conditions.

Since the issue of the Environmental Noise Assessment, I have reviewed the draft planning permit conditions circulated by DELWP for the amended Wind Energy Facility. The draft planning permit conditions are generally in accordance with the intent of my recommendations with the exception of proposed conditions 19 and 20 b)ii.

Draft condition 19 requires a preconstruction noise assessment to be conducted. However, this requirement is already covered in detail by draft conditions 21, 22 and 23. Therefore, it is my opinion that the condition is not required.

Draft condition 20 b)ii states:

where a high amenity noise limit has been found to be justified, as defined by section 5.3 of the Standard, for specific locations determined to be high amenity areas following procedures outlined in clause C5.3.1 of the Standard.

However, the assessment conducted in accordance with Section 5.3 of the Standard demonstrates that a high amenity noise limit is not justified. Therefore, it is my opinion that the condition is not required.

5 Declaration

I have made all the inquiries that I believe are desirable and appropriate and no matters of significance which I regard as relevant have to my knowledge been withheld from the Panel.

A handwritten signature in black ink, appearing to read 'C. Turnbull', written in a cursive style.

24 January 2017

Annexure A – Response to PPV Guide to Expert Evidence

Expert's Qualifications

My formal qualifications are an Honours Degree in Mechanical Engineering for which I studied between 1987 and 1990 and a Master of Engineering Science Degree, which was studied part time between 1992 and 1994. Both studies concentrated on the field of acoustics and both were obtained from the University of Adelaide.

Professional Associations

I am a member of the Australian Acoustical Society and I am the Sonus representative of the Association of Australian Acoustical Consultants.

Employment History and Achievements

I am presently the Principal Acoustic Engineer of Sonus Pty Ltd, an acoustical consulting practice, which I formed in 2002. Prior to this, my professional experience included 7 years at Bassett Acoustics (now AECOM) where I was an Associate and State Manager and 4 years as an Acoustical Engineer with the Maritime Operations Division of the Defence Science and Technology Organisation (DSTO).

I have more than 25 years of experience as an acoustic engineer. This experience includes the assessment of noise from more than 60 wind farms.

I have appeared as an expert witness in the Victorian Civil and Administrative Tribunal, the South Australian Environment Resources and Development Court, the New South Wales Land and Environment Court, and Victorian Panel Hearings for an extensive and diverse range of environmental noise issues including wind farms. Appearances include the Cherry Tree Wind Farm, Allendale Wind Farm, Mt Bryan Wind Farm and the Ararat Wind Farm.

I presented papers to the Wind Turbine Noise Conferences held in Rome in April 2011 and Denver in 2013.

Expertise to Make Report

My expertise is in the field of acoustics and vibration.

Instructions to Prepare Report

My instructions from Herbert Smith Freehills to prepare this report are repeated below:

*We would like you to prepare a witness statement in accordance with Planning Panel Victoria's Guide to Expert Evidence (**Guide**) which prescribes the content and form of expert witness statements. We enclose a copy of the Guide for your reference. You are required to review and understand the Guide and to ensure your witness statement addresses all matters set out in the Guide, in particular those matters listed under the heading 'Content and Form of Experts Report'. Please contact us if there is anything in this Guide which you do not understand, or if you have questions in relation to it. Your witness statement should include matters required as set out in the Guide such as:*

- (a) A reference to any technical report or reports that you rely upon;*
- (b) A statement to the effect that you adopt the findings in reports you helped to prepare and were submitted as part of the amendment application and identifying any departure from the findings and opinions you express in those reports;*
- (c) Any key assumptions made in preparing your witness statement.*

Once submissions have been received that are relevant to your area of expertise we will also request you consider those submissions and respond to any relevant matters in your witness statement.

Identity of Persons who have Carried out Tests or Experiments upon which Reliance has been Placed (if any)

I was assisted in the work, which is summarised in the Sonus Environmental Noise Assessment, by Jason Turner, Ashley Shepherd and Moharis Kamis. Jason, Ashley and Moharis all graduated with first class honours in Mechanical Engineering (concentrating on the field of acoustics) from the University Of Adelaide. All three are eligible for membership of the Australian Acoustical Society.

Annexure B – Detailed Response to Submissions

Issue	Submission No.	Response	Any Recommended New or Modified Conditions
General Noise Concerns	3, 6, 7, 9	An objective assessment of noise has been made. The assessment indicates compliance with NZS6808:2010.	Conditions are proposed, which require demonstration of achievement of NZS6808:2010.
Noise Criteria	6, 8, 10, 18, 23, 25, 26, 27, 28, 34, 40	<p>The “Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria” relevantly requires:</p> <p style="text-align: center;"><i>“an assessment of the noise impact of the proposal prepared in accordance with the New Zealand Standard NZS 6808:2010, Acoustics – Wind Farm Noise (the Standard), including an assessment of whether a high amenity noise limit is applicable, as assessed under Section 5.3 of the Standard (www.standards.co.nz).”</i></p> <p>The Sonus report presents an assessment of whether the predicted wind farm noise levels comply with NZS6808:2010 and considers the high amenity noise limit in Section 5.3 of this standard.</p>	Conditions are proposed, which require demonstration of achievement of NZS6808:2010.
Infrasound and Low Frequency Noise	3, 6, 8, 9, 10, 12, 14, 18, 22, 23, 25, 26, 27, 28, 34, 38, 39	Early wind turbines were constructed with blades located downwind of the mast. These turbines produced significant levels of infrasound (sound below 20Hz) as a result of the wake caused by the tower. Modern wind turbines are constructed with blades upwind of the mast resulting in noise levels well below the level of perception at residential setback distances and well below all infrasound criteria. International studies have confirmed that the level and character of noise from modern wind turbines is not different to the noise encountered from other natural	Conditions are proposed, which require demonstration of achievement of NZS6808:2010.

		<p>and non-natural noise sources.</p> <p>I have conducted studies into the level of infrasound produced by wind turbines. These studies confirm that the level of infrasound from wind turbines is no greater than naturally occurring levels of infrasound from sources such as waves breaking.</p> <p>The results of these studies were presented at the fourth International Conference Wind Turbine Noise 2011 in Rome¹ and appeared as a peer reviewed paper in "Acoustics Australia", the journal of the Australian Acoustical Society².</p> <p>Section 5.51 of NZS6808:2010 includes:</p> <p><i>although wind turbines may produce some sound at (ultrasound and infrasound) frequencies considered to be outside the normal range of human hearing these components will be well below the threshold of human perception.</i></p> <p>and</p> <p><i>claims have been made that low frequency sound and vibration from wind turbines have caused illness and other adverse physiological effects among a very few people worldwide living near wind farms. The paucity of evidence does not justify at this stage, any attempt to set a precautionary limit more stringent than those recommended.</i></p>	
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¹ Turnbull CP, Turner JP, "Measurement of Infrasound from Wind Farms and Other Sources" Fourth International Conference on Wind Turbine Noise Rome 11-14 April 2011

² Chris Turnbull, Jason Turner and Daniel Walsh "Measurement and level of infrasound from wind farms and other sources" Acoustics Australia Vol 40 No. 1 April 2012

<p>Health</p>	<p>3, 6, 8, 9, 12, 14, 18, 23, 25, 26, 27, 28, 34, 38, 40</p>	<p>Much of the speculation regarding the potential health effects of the noise from wind farms is based on the assumption that the noise from wind turbines is unique and therefore has the potential to cause health effects that other noise sources cannot. As an acoustic engineer, I am not qualified to express opinions about health impacts but I am able to say that the frequency content, character and level of noise from wind turbines, at typical setback distances to residences, is similar to the noise from many naturally occurring and mechanical noise sources.</p>	<p>Conditions are proposed, which require demonstration of achievement of NZS6808:2010.</p>
<p>Steven Cooper Study</p>	<p>3, 18, 28</p>	<p>The Association of Australian Acoustical Consultants (AAAC) conducted a review of the Steven Cooper report titled, "The results of an acoustic testing program Cape Bridgewater Wind Farm" (the Study). The outcome of the review is summarised below:</p> <p><i>"The overall conclusion drawn from the review is that the Study provides no new credible scientific evidence, and further, no scientific evidence to support the media reporting positively of the Study. The Study measures infrasound at the blade pass frequency and multiples of the blade pass frequency. The level of infrasound is similar to the levels measured previously by others and is well below the threshold of human perception. The Study suggests that there is a "pattern" of high severity disturbance associated with four turbine operating modes. When all data are considered, there are limitations, contradictory and limited data and the results do not support the description of a "pattern". The Study includes a hypothesis that "sensations" felt by the participants might be related to the measured level of infrasound. The hypothesis is based on a very limited subset of the data, with any data excluded from the analysis if it did not fit the theory. When all data are considered, the evidence does not support the hypothesis."</i></p> <p>Further, the study did not conduct an assessment of compliance with the conditions of approval but rather considered the experience of 6 residents living in the vicinity of the wind farm. The study included a conclusion that <i>"there is not enough data from this study to justify a change in regulation"</i>,</p>	

<p>More noise from larger turbines</p>	<p>3, 6, 9, 10,12, 14, 18, 22, 23, 25, 26, 27, 28, 34, 39, 40</p>	<p>It is not correct to state that the noise from a wind turbine is proportional to the size of the blades and therefore the noise increases proportionately with an increase in the swept area of the blades. On the contrary, over the years, the size of blades has increased dramatically without noise levels increasing significantly.</p> <p>The total noise energy emitted by a wind turbine is measured by the “sound power level”.</p> <p>In 2002 I conducted an assessment of a wind farm with NEG Micon 64C/1500 turbines with a rotor diameter of 64m. The highest sound power level for this turbine was 109 dB(A).</p> <p>The Stockyard Hill noise assessment has been conducted based on three examples of turbines with rotor diameters ranging between 126m and 140m. The highest sound power levels for these turbines range between 104 dB(A) and 106 dB(A).</p> <p>The environmental noise assessment demonstrates that the relevant criteria can be achieved with the larger turbines.</p>	<p>Conditions are proposed, which require demonstration of achievement of NZS6808:2010.</p>
<p>Vibration</p>	<p>9, 12, 28</p>	<p>Modern wind farms produce very low levels of ground vibration. I have measured the ground vibration at the base of a turbine of the Challicum Hills Wind Farm and at various distances from the turbine. The graph below compares the measured level of vibration against the recommendation of Australian Standard AS2670.2 for “critical areas” such as operating theatres, which have more onerous criteria than residences. The graph indicates that the level of vibration directly below the turbine, at 15m and at 350m was below the recommendation for “critical areas”. At residential distances, the ground vibration from wind turbines would be undetectable and well below the criteria for any land use including residences.</p>	

		<p style="text-align: center;">Comparison of Measured Vibration with AS2670.2</p> <p style="text-align: center;">Acceleration (m/s)</p> <p style="text-align: center;">1/3 Octave Band Centre Frequency (Hz)</p>	
<p>Assessment of compliance</p>	<p>8, 18, 30, 39</p>	<p>Compliance monitoring is addressed by the requirement for a Noise Compliance Test Plan in Condition 26, which is proposed to be substantially retained. Specifically the proposed condition requires:</p> <p style="text-align: center;"><i>Before the wind energy facility is commissioned, a noise compliance testing plan must be prepared to the satisfaction of the Minister for Planning meeting the following requirements:</i></p> <p style="text-align: center;"><i>a) the noise compliance testing plan must be prepared by a suitably qualified and</i></p>	<p>26 and proposed conditions which require demonstration of achievement of NZS6808:2010.</p>

		<p><i>experienced acoustics expert;</i></p> <p><i>b) the noise compliance testing plan must include a plan for noise monitoring to assess noise levels after construction of the wind energy facility and a plan for concurrent assessment of the presence or otherwise of special audible characteristics;</i></p> <p><i>c) the noise compliance testing plan must include advice on timing of the assessment including defining when commissioning of the wind energy facility, or an identified stage of it, will occur, and when the compliance noise monitoring results will be provided to the Minister for Planning;</i></p> <p><i>d) if the Wind Energy Facility is to be constructed in stages a noise compliance testing plan may be prepared for each stage before the development of that stage commences and those plans submitted to the Minister for Planning for approval provided that where a dwelling might be affected by noise from more than one stage that is accounted for;</i></p> <p><i>e) the noise compliance testing must be carried out at locations defined in Accordance with the Standard, including the consideration of alternative locations for assessment (if locations become inaccessible in the future).</i></p> <p><i>When approved, the plan will be endorsed by the Minister for Planning and then form part of this permit.</i></p> <p>Submission 18 states that the proposed condition addressing Special Audible Characteristics [SAC] simply provides for a penalty if they are found to be present and that this is not a sufficiently comprehensive treatment of SACs, and does not address the methods used to test for their presence. On the contrary, the proposed condition states:</p> <p><i>“where special audible characteristics, including tonality, impulsive sound or amplitude</i></p>	
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